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| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/526,059   | 10/13/2005  | Alexandre Ellison    | 35947-213490        | 2769             |
| 26694  | 7590        | 05/23/2008           |                     |                  |
| VENABLE LLP<br>P.O. BOX 34385<br>WASHINGTON, DC 20043-9998 |             |                      |                     |                  |
| EXAMINER   |             |                      |                     |                  |
| GUGLIOTTA, NICOLE T  |             |                      |                     |                  |
| ART UNIT   |             | PAPER NUMBER         |                     |                  |
| 1794   |             |                      |                     |                  |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/526,059

**Applicant(s)**

ELLISON ET AL.

**Examiner**

NICOLE T. GUGLIOTTA

**Art Unit**

1794

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 February 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1 - 6, 32 - 37 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 - 6, 32 - 37 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-8508)
- Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)
- Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Specification*

1. The amendment filed February 15, 2008 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: There is no support in the specification for the endpoints of the ranges stated in these claims, such as boron concentrations of  $5E14$  and  $5E15\text{ cm}^{-3}$ , transition metal impurities as low as  $10^{13}$ , or the use of annealing above  $700^{\circ}\text{C}$ .

Applicant is required to cancel the new matter in the reply to this Office Action.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 5, 32, 36, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter, Jr. et al. (U.S. Patent No. 6,218,680 B1).

4. In regard to claim 1, Carter, Jr. et al. disclose a semi-insulating bulk single crystal of silicon carbide at room temperature with carrier concentrations less than  $10^{15} \text{ cm}^{-3}$  (Col. 4, Lines 45 - 56, Figure 1, Figure 16).

5. In regard to claim 2, Carter, Jr. et al. disclose the silicon carbide semi-insulating single crystal will have a concentration of nitrogen of  $5 \times 10^{16}$  or less (Col. 5, Lines 23 – 26). The silicon carbide single crystal comprises shallow donor dopants, show acceptor dopants (Col. 8, Lines 44 – 46).

6. Carter, Jr. et al. would inherently have the same carrier lifetime as applicant because they have used the same water material (SiC), same shallow nitrogen dopant, same carrier concentrations (less than  $10^{15} \text{ cm}^{-3}$ ), etc.

7. In regard to claim 5, Carter, Jr. et al. disclose seed crystal sublimation. If a seed is oriented on-axis within the crucible of the seed holder (Col. 6, Lines 34 - 37), then the surface of the wafer will grow on-axis, parallel to a Miller index plan.

8. In regard to claim 32, Carter, Jr. et al. disclose heating the silicon carbide source powder until a desired amount of single crystal bulk growth (corresponds to applicant's "boule") has occurred upon the seed crystal (Col. 5, Lines 53—56).

9. In regard to claim 36, Examiner interprets this to be a product-by-process claim. Examiner refers applicant to MPEP § 2113 [R - 1] regarding product-by-process claims. "The patentability of a product does not depend on its method or production. If the

Art Unit: 1794

product in the product-by-process claim is the same as or obvious from a product or the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777, F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (citation omitted)

Once the examiner provides a rationale tending to show that the claimed product appears to be same or similar to that of the prior art, although produced by a different process, the burden shifts to the applicant to come forward with evidence establishing an unobvious difference between the claimed product and the prior art product. *In re Marosi*, 710 F.2d 798, 802, 218, USPQ 289, 292 (Fed. Cir. 1983)

In regard to the carrier lifetime of claim 36, Examiner directs applicant to argument made above for claim 1.

10. In regard to claim 37, Carter, Jr. et al. disclose the use of silicon carbide wafers for microwave applications, such as semiconductor electronic devices and resulting circuits (Col. 1, Lines 14 – 36).

11. Claims 3, 4, 6, and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter, Jr. et al., in view of Precht et al. (U.S. Patent No. 5,043, 773).

12. In regard to claim 3, Carter, Jr. et al. is silent in regard to the slicing of the single crystal bulk after it is made.

13. Precht et al. disclose a single crystal ingot is then oriented by X-ray diffraction to facilitate the slicing of wafers with a known crystallographic orientation (Col. 14, Lines 1 - 5).

14. In regard to claim 4, Carter, Jr. et al. is silent in regard to wafer polishing.

15. Precht et al. disclose the wafers are polished using a standard lapping wheel (Col. 14, Lines 8 - 15).

16. It would have been obvious to one skilled in the art at the time the invention was made that SiC wafer bases are produced by slicing and then polishing the wafers so that a semiconductor may be produced on it, as disclosed by Precht et al.

17. In regard to claims 6 and 33, the thickness of the wafer is dependent on the amount of time allowed for the single crystal boule to grow and the person slicing the boule. Therefore it would be obvious to one skilled in the art at the time the invention was made to allow the deposition of SiC single crystal to grow into a boule far larger than 150  $\mu\text{m}$ , as disclosed in claim 32, and slicing the originally produced crystal, as disclosed in Claim 3, into wafers with thicknesses greater than 150  $\mu\text{m}$ . The desired thickness of the wafer is dependent upon the application, such as for the manufacturing of semiconductors. Precht et al. disclose wafers having a thickness of 0.5 - 1.0 mm (500 - 1000  $\mu\text{m}$ ) are preferred (Col. 14, Lines 6 - 7).

18. Claims 34 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter, Jr. et al., in view of Seefeldt et al. (U.S. Patent No. 5,736,430).

Art Unit: 1794

19. In regard to claims 34 and 35, Carter, Jr. et al. disclose the concentration of vanadium is accordingly less than  $1\text{E}16$  atoms per cubic centimeter, and most preferably less than  $1\text{E}14$  atoms per cubic centimeter (Col. 5, Lines 29 - 32). Figures 1 and 6 disclose carrier concentrations lower than  $1\text{E}12\text{ cm}^{-3}$ . Examiner considers vanadium to contribute to this low carrier concentration. Carter, Jr. et al. are silent in regard to the presence of boron in the SiC wafer.

20. Seefeldt et al. disclose a silicon wafer doped with p-type boron dopant with a carrier concentration between  $1\times 10^{15}\text{ cm}^{-3}$  and  $1\times 10^{16}\text{ cm}^{-3}$  (Col. 4, Lines 1 - 5).

21. It would have been obvious to one skilled in the art at the time the invention was made to decrease the amount of impurities/dopants, such as boron, in a single crystal silicon carbide wafer as much as possible. Seefeldt et al. disclose boron concentrations as low as  $1\text{E}15$ . It would have been obvious to one skilled in the art at the time the invention was made to improve upon this value.

### ***Response to Amendment***

22. The amendment filed February 15, 2008 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: There is no support in the specification for the endpoints of the ranges stated in these claims, such as concentrations of  $5\text{E}14$  and  $5\text{E}15\text{ cm}^{-3}$  of boron, transition metal impurities as low as  $10^{13}$ , or the use of annealing above  $700^{\circ}\text{C}.$

Applicant is required to cancel the new matter in the reply to this Office Action.

***Response to Arguments***

23. Applicant argues "neither Kordina et al. nor Larkin discloses the present invention as recited in claim 1 since, among other things, neither reference discloses a uniform single crystal of silicon carbide in the form of a wafer. Both Kordina et al. and Larkin disclose an epitaxial layer on a substrate that together form a wafer."
24. Applicant argues "Larkin et al. point out that the substrate is merely a starting point and carrier of the epitaxial layers. It is incorrect to assume that substrate and epilayer are the same and that they have the same properties."
25. Applicant argues "Clearly, a boule is not equivalent to an epitaxial layer, nor has the properties of the epitaxial layers disclosed by Larkin et al."
26. Applicant argues "Since the substrate disclosed by Larkin et al. is used to support an epitaxial layer, it is the epitaxial layer together with the substrate that constitute a wafer in Larkin, not the substrate alone."
27. Applicant argues "The structures suggested by the cited references suffer from the problem that the substrate introduces an undesired resistance. A person skilled in the art facing this problem would seek to reduce the resistance in the substrate but keeping the epitaxial layer. This since an epitaxial layer on a substrate was the only known solution providing the other desired properties, which are more important than lowering the substrate resistance. Removing the substrate would not be a viable option to a person skilled in the art for the above reasons."



28. Applicant's arguments with respect to claims 1 - 6 have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

29. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to NICOLE T. GUGLIOTTA whose telephone number is (571)270-1552. The examiner can normally be reached on M - Th 8:30 - 6 p.m., & every other Friday.

Art Unit: 1794

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carol Chaney can be reached on 571-272-1284. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

NICOLE T. GUGLIOTTA  
Examiner  
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/Carol Chaney/  
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